PRELIMINARY SURVEY OF ORIBATID MITES (ACARI: ORIBATIDA) FROM ZION NATIONAL PARK, UTAH[1]

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ABSTRACT: Oribatid mites were collected from five habitat sites differing in elevation (1300-2405m) and moisture content in Zion National Park, Utah. A total of 36 families, 56 genera, and 76 species were identified with approximately 73% of the species undescribed. Five species were present at all five sites while 42 species were present only at single sites.

The terrestrial habitat with the greatest species richness and phylogenetic diversity is soil, most particularly wherever dead plant and animal remains accumulate and mix with inorganic soil particles (Behan-Pelletier and Bissett 1992). Arthropods are especially diverse in such soils and include sowbugs (Isopoda), millipedes, centipedes, symphylans, pauropods, spiders, pseudoscorpions, and many kinds of insects and mites. The arthropod group with the greatest abundance and diversity in most soils is the mite suborder Oribatida. However, it is estimated that only 10% of North American oribatid species have been described, the lowest percentage of all arthropod taxonomic groups (Behan-Pelletier and Bissett 1992). Identification by non-specialists is hampered by the few reliable keys available to genera and species and by the lack of generic and family-level revisions. Identification of immature stages is even more difficult. The objective of this study was to collect and identify the oribatid mites from habitats in different areas of Zion National Park, Utah. Only one oribatid species, *Gymnodamaeus umbraticus* Paschoal, has been recorded from Zion National Park, and the park is the type locality (Paschoal 1982).

MATERIALS AND METHODS

Zion National Park, located in southwestern Utah, has elements of several vegetative types found in western United States. Vegetation is influenced by an annual rainfall of 10-20 inches (25.4-50.8cm) per year which usually occurs as winter/early spring and late summer wet cycles. Winters are short and mild, summers are long and hot. The Virgin River runs from north to south through the Zion Canyon. Along its banks are Fremont cottonwoods *(Populus fremontii* Wats.), willow *(Salix* sp.), boxelder *(Acer negundo* L.) and ash *(Fraxinus* sp.) while on higher ground nearby the dominant trees are gambel oak *(Quercus*

[1] Received February 13, 1995, Accepted July 28, 1995.

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gambelii Nutt.), rocky mountain maple (*Acer glabrum* Torr.) and juniper (*Juniperus* sp.). In certain places water either flows down surfaces of rock walls or drips down from above (i.e. Weeping Rock, see below) providing a special habitat for herbaceous plants and mosses. At approximately 1000-1400m elevation outside the canyon is a semidesert zone on which grows juniper (*Juniperus* sp.), pinyon pine (*Pinus edulus* Engelm.) and live oak (*Quercus* sp.) (i.e. Lava Point Road, see below). At higher elevations (1400m and higher) the dominant trees are Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), ponderosa pine (*Pinus ponderosa* Dougl.), white fir (*Abies concolor* Lindl. & Gord.) and quaking aspen (*Populus tremuloides* Michx.).

Collections were made in Zion National Park on July 12-14, 1993: 1) Gateway to the Narrows along the Virgin River (approximately 1300m), 2) Lava Point (2405m), 3) Lava Point Road (1365m), 4) Emerald Pool Trail (approximately 1435m) and 5) Kolob Canyons (approximately 1800m). The materials sampled in each of the 22 samples are as follows:

1) Gateway to the Narrows
    Weeping Rock
        grass litter (RM R93-55)
    Gateway to Narrows
        sifted hardwood leaf litter (RMR93-56)
        sifted cattail/equisetum litter (RMR93-57)
        sifted maple, oak leaf litter (RM R93-58)
        sifted rotten wood, litter by log in flat (RMR93-59)
        wet moss by rock wall (RMR93-60)
        plants on rock wall (RMR93-61)
        moss on wet wall (RMR93-62)
2) Lava Point area
    Lava Point
        sifted Douglas-fir leaf litter (RMR93-63)
        sifted leaf litter under oak, shrubs (RMR93-64)
    One half mile from Lava Point
        sifted quaking aspen leaf litter (RM R93-65)
        sifted ponderosa pine litter (RMR93-66)
        sifted rotten wood (RMR93-67)
3) Lava Point Road, 9 mi North of Virgin
        sifted pinyon pine/juniper/oak leaf litter (RMR93-68)
4) Emerald Pool Trail
        sifted oak/maple/juniper leaf litter (RMR93-69)
        sifted oak litter (RMR93-70)
        moss and lichens on rocks (RMR93-71)
        sifted Douglas-fir/juniper/oak/maple leaf litter (RMR93-72)
5) Kolob Canyons area
        sifted juniper leaf litter (RMR93-73)
        sifted pinyon pine leaf litter (RMR93-74)
        sifted oak leaf litter (RMR93-75)
        sifted juniper leaf litter (RMR93-76)

Sifted samples were taken using a standard size canvas sweep net, covering the opening with 1/2 inch mesh galvanized hardware cloth, placing the material

to be sampled on top of the hardware cloth and shaking the net. The smaller particles falling into the net were placed in plastic bags for storage and shipment.

Sample size varied depending on the substrate sampled with most sifted samples filling gallon-sized plastic freezer bags. Very wet substrates or substrates from rock surfaces which could not be sampled by sifting were generally much smaller.

These samples were stored in plastic foam coolers and kept from overheating. Moisture was added to dry location samples to encourage mites to become active. Extraction using Berlese funnels began July 16 after return to New Hampshire. Extracts were checked daily until no more mites appeared, with all extractions completed by August 8, 1993.

During the sorting process representatives of each form of oribatid mite were removed and put into dishes containing lactic acid to clear specimens. All oribatids were removed in those samples with few specimens. Specimens were identified in temporary mount slides (depression slides with a cover slip over one edge) in lactic acid. Representatives of each species were mounted in Hoyer's medium and ringed with red GLPT insulating varnish to prevent dehydration. Some species required dissection to see important diagnostic characters.

Identification of specimens was first made to genus using Balogh and Balogh's (1992) world key to genera. A list of the described species in each genus was obtained from the oribatid catalog (Marshall *et. al.* 1987) and comparisons made to the literature citations for each species. Some comparisons were made to material in the Canadian National Collection (CNC) and Valerie Behan-Pelletier at CNC confirmed some of the more difficult identifications. Voucher specimens will be deposited in the United States National Museum.

RESULTS

A qualitative assessment of the families, genera, and species from each of the five areas is provided in Table 1. Thirty-six families, 56 genera, and 76 species of oribatid mites were represented. Included were two new genera and 51 new species, 73% of those species encountered.

A wide range in moisture and elevational characteristics was present among the samples and influenced distribution of many of the mite species. In the Narrows area near the Virgin River samples #55, #60, #61 and #62 were taken on or near wet rock surfaces. The wettest sample, #60, was partly in standing water and is the only sample containing *Hydrozetes* sp. This sample also contained water mites (Hydrachnellae) and damselfly naiads (Odonata). Two additional samples, #57 and #59, from the flat next to the river in the Narrows area, also contained moist conditions, with #57 at the edge of a small swampy location. Sowbugs (Isopoda) were abundant in these two samples. Among the eleven additional species found only in these wet samples are three species of

Malaconothrus, a genus that is known to prefer wet habitats (Rajski 1961, Travé 1963). In the Narrows area but collected away from the river on a dry hillside were samples #56 and #58. These contained five species found nowhere else. *Aeroppia* sp. was found only in the Narrows samples but from both wet and dry locations.

At Lava Point, the highest elevation sampled, ponderosa pine, Douglas-fir and white fir provided a denser vegetative cover and greater accumulation of organic matter on the forest floor. Samples #63-66 were dry, however sample #67 was collected at greater depth and moist conditions were present. Sample #67 produced nearly all the 13 species found only at Lava Point, including *Brachychthonius* sp. and *Eobrachychthonius* sp. The Brachychthoniidae, including the *Liochthonius* from the wet Narrows samples, are very small (200-250 µm long) weakly sclerotized mites and were present only in samples with moderate to high moisture content.

The most xeric site was the single sample taken under pinyon pine, juniper and oak on the Lava Point Road. Only *Lucoppia* sp. #1 was unique to this location.

Of the four samples taken at the Emerald Pool area, #71 (moss and lichens on rocks) contained *Lucoppia* sp. #2, the only oribatid species in this sample, and #72 (a north facing slope with Douglas-fir and ponderosa pine present) contained *Licnodamaeus* sp. #1 and *Eupterotegaeus rhamphosis,* the only samples where these species were present.

Seven species were found only in the Kolob Canyon samples.

DISCUSSION

Species found on all five collection sites at Zion National Park are *Camisia biverrucata, Gymnodamaeus umbraticus, Joshuella* sp. #1, *Tectocepheus* sp., and *Propelops canadensis.* Two of these species, *Camisia biverrucata* and *Joshuella* sp. #1, were absent in all the wet samples at the Narrows. Five additional species were found on four of the five collection sites: *Trhypochthonius americanus* was absent from Lava Point and the wet samples in the Narrows, *Ametroproctus oresbios* from Emerald Pool area, and *Belbodamaeus* sp., *Liacarus* sp. #1, and *Trichoribates* sp. absent from the single Lava Point Road sample. All of these species have thick integuments or, like *C. biverrucatus,* produce a body surface coating of cerotegument to which dirt particles often adhere. Their integumental structure may have influenced their survivability in very dry situations.

In summary 42 of the 76 species collected were found at one site only. The sites with the most species in common (32%) were Lava Point and Emerald Pool. These two sites have the highest elevations and a very similar vegetative cover. The site comparisons with the least number of species in common (20%) were the Narrows with Lava Point Road, and Lava Point with Lava Point Road.

Samples from the Narrows and Lava Point had the highest moisture content while the Lava Point Road samples came from the most xeric site.

Taxonomic revisions at the family level are important sources of information for faunal studies but few exist for the oribatids. The recent revision of the Eremaeidae of North America by Behan-Pelletier (1993) was most helpful. Of the eight species of eremaeids collected in this study two were described by Higgins and five were newly described by her. Only one was a new species.

Table 1. Oribatid families, genera and species present on the five habitat sites at Zion National Park, Utah. Species marked with asterisk (*) are new records for Utah. Listing of families follows that of Balogh and Balogh (1992).

Family/Species	**Narrows**	**Lava Point**	**Lava Point Road**	**Emerald Pools**	**Kolob Canyon**
Hypochthoniidae					
**Hypochthonius luteus* Oudemans	+				
Cosmochthoniidae					
**Cosmochthonius lanatus* (Michael)	+		+		
Brachychthoniidae					
Brachychthonius sp.		+			
Eobrachychthonius sp.		+			
Liochthonius sp.	+				
Phthiracaridae					
Atropacarus sp.	+	+		+	
Hoplophthiracarus sp.	+				
Oribotritiidae					
**Mesotritia brachytrix* Walker		+			
Euphthiracaridae					
Rhysotritia ardua (C. L. Koch)	+	+		+	
Camisiidae					
**Camisia biverrucata* (C. L. Koch)	+	+	+	+	+
**Camisia lapponica* (Tragardh)		+			
Trhypochthoniidae					
**Trhypochthonius americanus* (Ewing)	+		+	+	+
Malaconothridae					
**Malaconothrus gracilis* v. d. Hammen	+				
Malaconothrus sp. #1	+				
Malaconothrus sp. #2	+				

Family/Species	Narrows	Lava Point	Lava Point Road	Emerald Pools	Kolob Canyon
Hermaniellidae					
Hermaniella sp.	+	+		+	
Gymnodamaeidae					
Gymnodamaeus umbraticus Paschoal	+	+	+	+	+
Joshuella sp. #1	+	+	+	+	+
Joshuella sp. #2		+	+		
Pleodamaeus plokosus (Woolley & Higgins)		+		+	
Plateremaeidae					
Allodamaeus sp.	+				
Licnodamaeidae					
Licnodamaeus sp. #1				+	
Licnodamaeus sp. #2					+
Damaeidae					
Belbodamaeus sp.	+	+		+	+
Caenobelba sp.		+			
Cepheidae					
**Eupterotegaeus rhamphosis* Higgins & Woolley				+	
Eupterotegaeus sp.	+				
Charassobatidae					
Ametroproctus oresbios Higgins & Woolley	+	+	+		+
Eremaeidae					
Eremaeus monticolus Behan-Pelletier		+		+	
**Eremaeus oresbios* Behan-Pelletier		+			+
Eremaeus sp.		+			
**Eueremaeus alvordensis* Behan-Pelletier					+
Eueremaeus chiatous (Higgins)		+			
Eueremaeus danos Behan-Pelletier		+			
**Eueremaeus lindquisti* Behan-Pelletier	+		+	+	
Eueremaeus tetrosus (Higgins)		+	+		
Liacaridae					
Dorycranosus sp.					+
Liacarus sp. #1	+	+		+	+
Liacarus sp. #2	+				

Family/Species	Narrows	Lava Point	Lava Point Road	Emerald Pools	Kolob Canyon
Tectocepheidae					
Tectocepheus sp.	+	+	+	+	+
Oppiidae					
Aeroppia sp.	+				
**Microppia simplex* (Jacot)		+			
Multioppia sp.		+			
Oppia sp.	+				
**Oppiella nova* (Oudemans)	+	+			
Quadroppiidae					
Quadroppia sp.	+	+			+
Suctobelbidae					
Suctobelba sp.		+			
Suctobelbella sp.	+				
Hydrozetidae					
Hydrozetes sp.	+				
Cymbaeremaeidae					
Scapheremaeus sp.		+	+		
Scutoverticidae					
Exochocepheus sp. #1			+	+	+
Exochocepheus sp. #2				+	
Exochocepheus sp. #3	+				
Xylobatidae					
Xylobates sp.	+				
Oribatulidae					
Gerloubia sp.					+
Lucoppia sp. #1			+		
Lucoppia sp. #2				+	
Lucoppia sp. #3	+				
Paraphauloppia sp.	+				
Oribatula sp.	+	+			
Zygoribatula sp. #1					+
Zygoribatula sp. #2					+
?genus		+			
Haplozetidae					
Peloribates sp.		+		+	
Scheloribatidae					
Hemileius sp.	+				+
Scheloribates sp. #1	+	+			
Scheloribates sp. #2	+				
Ceratozetidae					
Trichoribates sp.	+	+		+	+
?genus		+			

Family/Species	Narrows	Lava Point	Lava Point Road	Emerald Pools	Kolob Canyon
Mycobatidae					
Punctoribates sp.	+				
Humerobatidae					
Humerobates sp.		+			
Phenopelopidae					
**Propelops canadensis* Hammer	+	+	+	+	+
Oribatellidae					
Oribatella sp. #1	+				
Oribatella sp. #2		+			+
Tegoribatidae					
Lepidozetes sp.		+			
Galumnidae					
Pilogalumna sp.		+		+	
Total Families - 36	**29**	**25**	**11**	**18**	**16**
Genera - 56	**36**	**34**	**12**	**21**	**20**
Species - 76	**40**	**40**	**14**	**22**	**21**

ACKNOWLEDGMENTS

I thank Zion National Park personnel with providing me with a collecting permit and help in guiding me to collection locations, Valerie Behan-Pelletier, Centre for Land and Biological Resources Research, Ottawa, Ontario, Canada for help in confirming some of the species identifications, and D. S. Chandler, Department of Entomology, University of New Hampshire, for review of the manuscript.

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